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(54) **Combustion engine pull-cord start system**

Seilzugstartsystem für Brennkraftmaschine

Système de démarrage par câble pour moteur à combustion

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- **PATENT ABSTRACTS OF JAPAN** vol. 014, no. 464 (M-1033), 9 October 1990 (1990-10-09) & JP 02 185671 A (YANMAR DIESEL ENGINE CO LTD), 20 July 1990 (1990-07-20)
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Description**Field of the Invention**

[0001] The present invention relates generally to a combustion engine start system and more particularly to a pull-cord start system for automatic actuation of a carburetor or other starting device.

Background of the Invention

[0002] Small internal combustion engines which are typically utilized for recreational vehicles and garden implement applications such as chain saws, tractors and lawn mowers have pull-cord type start systems. The operator of the garden tool or vehicle must manually pull a retractable cord attached to a recoil pulley which rotates a crank shaft for starting of the combustion engine. The cord automatically retracts when released by the user about the pulley which is connected to a torsional coil spring device.

[0003] In a conventional recoil starter mechanism, pulling the cord rotates the recoil pulley which through a one way clutch or coupling rotates the crankshaft to start the engine. In a so called spring starter mechanism, pulling the cord rotates the recoil pulley which winds up a torsion spring which when released unwinds to rotate, through a one way clutch or coupling, the crankshaft to start the engine. In both the recoil and spring starter mechanisms, the one way clutch or coupling allows the crankshaft of the running engine to rotate freely relative to the recoil pulley.

[0004] Unfortunately, when the cold engine is initially started the user must first remember to manually close the choke valve to deliver a rich mixture of fuel-and-air to the engine when the cord is pulled. Moreover, and if the engine was shut down with the exhaust and intake valves closed (i.e. compression stroke of the engine), pulling of the cord is difficult and may actually snap back into the pulley housing because the trapped air within the combustion chamber resists compression essentially locking the piston and crankshaft in their arbitrarily shut-down position.

[0005] DE 94 02 559 U1 discloses a pull cord start system for a combustion engine according the preamble of claim 1.

[0006] From DE 40 162 224 A1 a device is known for improving the start of combustion engines. The known device addresses the problem to alternate the start procedure of the engine such that starting of the engine is possible without particular adjustment measures of the operator. The known system consists of an actuation cord, connecting preferably a recoil starter with the valve lifter or the decompression valve. The actuation of the valve lifter or the decompression valve is automatically effected by pulling the actuation cord during the start procedure. In the known device the starter cord is operably connected with the valve lifter or the decompression

valve and the carburetor at the same time.

[0007] DE 196 18 699 A1 discloses a combustion engine for a manually operated device. In order to reduce compression during the start procedure of the engine a decompression valve is provided. A carburetor associated with the combustion engine includes a throttle valve and a choke valve. In order to adjust the fuel/air mixture immediately after starting the engine, means for mechanical coupling are provided between the decompression valve and the choke valve, said means allowing to detect a closing movement of the decompression valve. Dependent on this movement the choke valve is shifted from the start position to an operation position.

[0008] US 3 361 124 A describes a rope pull starter for internal combustion engines. According to the known starter the rope is guided in a fixed path when tensioned, and is deflected from that path by a spring loaded deflector member when slack. When the rope is tensioned the deflector member is moved against the restraint of its spring, and the movement is transmitted by a linkage to a decompression valve on the engine. In this way the cranking effort shall be reduced. The movement of the deflector member is also transmitted to a fuel injection pump or to a choke in the carburetor to enrich the fuel mixture during cranking of the engine by the pulled rope.

[0009] JP 0 218 56 71 discloses a starter device for Diesel engines, particularly a carburetor with a choke control system. It is suggested to close a throttle valve in the first suction stroke of the engine, so that air passes through a hole in the throttle valve to be supplied to a combustion chamber. Thereby the amount of suction air shall be throttled, so that no large force is required to lift the piston in the compression stroke of the engine. In this way the necessary force for pulling the rope shall be reduced.

Summary of the Invention

[0010] The object of the invention is to provide a pull cord start system which is compact in construction, of relatively simple design, of low cost when mass-produced, and is rugged, durable, reliable, requires little maintenance and no adjustment in use, and in service has a long useful life.

This object is met according to the invention with the pull cord start system according to claim 1.

[0011] A pull-cord start system of a combustion engine has a remote start assist device that is automatically actuated upon the initial pull of a pull-cord of a recoil starter assembly. The assembly has a releasable coupling which intermittently engages a recoil pulley of the recoil starter assembly about which the cord is wound. Upon the initial pull of the cord, a shuttle of the coupling moves generally with the pulley, pulling upon a linkage constructed and arranged to actuate the external start device. Upon release of the cord, the shuttle and the remote start assist device automatically re-align themselves.

[0012] The releasable coupling has a roller engaged

rotatably to the shuttle and disposed radially outward from the pulley. A winding of a plurality of windings of the cord is wound or encompasses both the pulley and the roller with the remaining windings being either wound about just the pulley and/or withdrawn from a housing of the recoil starter assembly which generally houses both the pulley and the shuttle.

[0013] Preferably the start assist device is a carburetor having a choke valve operatively associated with a throttle valve. Upon initial pulling of the cord of the recoil starter assembly, movement of the releasable coupling pulls upon a linkage, which closes the choke valve and partially opens the throttle valve. Upon release of the cord, the pulley automatically recoils the cord and the releasable coupling moves back, thus negating the pulling force upon the linkage which allows the yieldably biased open choke valve to partially open to an engine warm-up position while the throttle valve remains in a partially open position until the operator actuates a throttle pedal or trigger to increase engine speed.

[0014] Objects, features and advantages of his invention include a reliable starting engine having a simplified start-up procedure, elimination of pull-cord kickback, and elimination of the engine stalling on an overly rich mixture of fuel-and-air. Moreover, the pull-cord start system is compact in construction, relatively simple in design, of low cost when mass produced, and is rugged, durable, reliable, requires little maintenance and no adjustment in use, and in service has a long useful life.

Brief Description of the Drawings

[0015] These and other objects, features and advantages of this invention will be apparent from the following detailed description, appended claims, and accompanying drawings in which:

FIG. 1 is a combined partial section view of a recoil starter assembly of a pull-cord start system of the present invention illustrated in an unwound state; and aside view of a carburetor of the pull-cord start system linked to the starter assembly and illustrated in a closed position with a throttle valve substantially open;

FIG. 2 is a section view of the pull-cord start system illustrated in a recoiling state with the carburetor illustrated in an engine warm-up orientation;

FIG. 3 is a section view of the pull-cord start system illustrated in a recoiled state and wherein the choke valve is illustrated in the engine warm-up orientation;

FIG. 4 is a section view of the carburetor of the pull-cord start system with the throttle valve at idle and the choke valve fully open;

FIG. 5 is a section view of the carburetor of the pull-cord start system illustrating the throttle valve opening from the idle position and the choke valve closing from the open position to a partially closed position when the cord is pulled from the released state;

FIG. 6 is a partial section view of the pull-cord start system taken along line 6-6 of FIG. 1;

FIG. 7 is a partial section view of a first modification of a pull-cord start system;

FIG. 8 is a partial section view of a second modification of a pull-cord start system;

FIG. 9 is a section view of a third modification of a pull-cord start system; and

FIG. 10 is a section view of a fourth modification of a pull-cord start system.

Detailed Description of the Preferred Embodiments

[0016] Referring in more detail to the drawings, FIGS. 1-3 illustrate a pull-cord start system 20 of the present invention preferably utilized on small displacement internal combustion engines which commonly require a manual pull-cord recoil starter assembly 22 for starting the engine. When a pull-cord 24 of the recoil starter assembly 22 is pulled by an operator against a rotational bias of a pulley or spindle 26 through a cord conduit 28 carried by a housing 30 of the assembly 22, a crank shaft of the engine is rotated at a speed sufficient to start the engine. The pulley 26 is connected by a one way clutch or coupling to drive the crankshaft as the cord is pulled and to permit the crankshaft to freely rotate relative to the pulley when the engine is running. During initial unwinding of the cord 24 from a recoiled state 32 (as best shown in FIG. 3), the pull-cord start system 20 not only begins to rotate the crankshaft, but also actuates an external start assist device 34 which may include, but is not limited to, a carburetor as illustrated in FIGS. 1-3 and 4-5, and/or a combustion chamber pressure relief valve as illustrated in FIG. 10.

[0017] When starting the engine, the operator manually grasps a handle 36 attached to a first distal end 38 of the cord 24 and pulls the cord 24 outward from the housing 30 which turns the pulley 26 in a counter-clockwise direction (as viewed in FIG. 1) against the bias of a torsional spring (not shown) generally engaged between the pulley 26 and the housing 30. The operator must pull the cord with sufficient strength to overcome the bias of the pulley recoil spring which would otherwise cause the cord 24 to rewind back into the housing 30 within a circumferential groove 40 carried by the pulley 26 and opened generally radially outward, as best illustrated in FIG. 6. As the cord 24 is pulled outward toward an unwound state 42 (as best illustrated in FIG. 1) the recoil pulley 26 engages the crankshaft of the engine causing the piston(s) to reciprocate with sufficient speed to start the engine. When the cord 24 is released by the operator, the recoil spring (not shown) causes the pulley 26 to rotate clockwise through a series of complete revolutions. Because an opposite second end 44 of the cord 24 is engaged directly to the pulley 26, the cord 24 travels with the pulley and recoils back into the housing 30 (i.e. a recoiling state 46 as best illustrated in FIG. 2) until the handle 36 nestles or seats against the housing 30 prox-

imate to the conduit 28, thus placing the recoil starter assembly 22 into the recoiled state 32, as best illustrated in FIG. 3.

[0018] The recoil starter assembly 22 interacts with the start assist device or carburetor 34 via a releasable or slip coupling 48 of the assembly 22 which connects to a choke valve 50 of the remotely located carburetor 34 by an elongated linkage 52, which is preferably a Bowden wire. The cord 24 has a plurality of windings, with a first winding 54 having the first cord end 38 connected directly to the handle 36 and a last winding 56 having the second end 44 connected to the pulley 26. Automatic positioning of the choke valve 50 to assist in starting the engine occurs generally during the first counter-clockwise rotation of the pulley 26 from the recoiled state 32, and thus during the withdrawal of the first winding 54 from the housing 30. This enables the remaining windings or revolutions of the pulley 26 to actually start the engine after the choke valve 50 and throttle valve of the carburetor 34 have been automatically positioned for optimum starting.

[0019] When the recoil starter assembly 22 is in the recoiled state 32, a shuttle 58 of the releasable coupling 48 is preferably generally centered in a circumferentially extending channel 60 defined radially between the housing 30 and a generally circular surface or pair of peripheral edges 62 of the pulley 26. The pulley groove 40 is defined laterally between the axially spaced edges 62 of the pulley 26.

[0020] During the initial pull of the cord 24 or during withdrawal of the first winding 54 from the housing 30, the shuttle 58 of the releasable coupling 48 moves counter-clockwise with the pulley 26 and within the channel 60 due to a frictional interface 61 engagement between the shuttle 58 and the pulley 26, and/or a torsional force (indicated by arrow 63) created by the orientation of the coupling 48 with the particular winding generally disposed within the housing 30 and adjacent the conduit 28. The shuttle 58 moves counter-clockwise until the shuttle 58 contacts a stop 64 carried by the housing 30 at which point the shuttle is in an actuated state 65. Upon contact, the shuttle 58 has moved a sufficient angular distance to actuate the start assist device or carburetor 34 via the linkage 52 which is connected to a radially projecting lever 66 of the shuttle 58 that extends through a slot 68 of the housing 30. With the shuttle 58 in the actuated state 65 or pressed against the stop 64, the remaining windings of the cord 24 are withdrawn from the housing 30 by the operator's continuing pull causing the pulley 26 to continue its rotation.

[0021] During this remaining or continuing pull, the frictional interface 61, formed by the contact between a radially inward concave face 70 of the shuttle 58 and the axially outward lying edge portions of the circular surface 62 of the pulley 26, is overcome by the pulling force exerted upon the cord 24 by the operator. Therefore, the pulley 26 continues to rotate counter-clockwise as the cord 24 is withdrawn from the housing 30 and as the coupling 48 remains stationary. The circumferential lo-

cation of the stop 64 generally lies within the range of ninety to one hundred and twenty degrees away and in a clockwise direction from the conduit 28 which generally locates the channel 60 (i.e. coupling travel range) diametrically opposite the conduit 28. This generally diametrically opposed orientation assures that the releasable coupling 48 does not become bound or entangled proximate to the conduit 28 of the housing 30.

[0022] The frictional interface 61 between the surface 70 of the shuttle 58 and the surface 62 of the pulley 26 is induced or caused by a reactive force (identified as arrow 72) directed generally radially inward with respect to the pulley 26. Force 72 is produced by the looping of one of the windings of the plurality of windings of the cord 24 both over a roller 74 of the releasable coupling 48, supported rotatably by the shuttle, and the pulley 26. The roller 74 is disposed radially outward from the pulley 26 and is substantially centered axially with respect to the pulley over the groove 40. An alcove 76 of the shuttle 58 houses the roller 74 and opens radially inward so that any one winding of the cord 24 can be diverted from the groove 40 of the pulley 26, as it is routed over the roller 74 and then return back into the groove 40.

[0023] The contour or profile of the roller 74 forms a circular valley or V-groove 78 which axially centers the cord 24 to the roller 74. A rotational axis 80 of the roller 74 is orientated substantially parallel to a central axis 82 of the pulley 26. Pulling of the cord 24 by the operator creates a tension in the cord which biases the roller 74 and shuttle 58 radially inward against the pulley 26. This biasing force is represented by arrow 72. Because the cross section of the shuttle 58 is generally U-shaped and inverted, as illustrated in FIG. 6, the surface 70 has two parallel edge portions 84, 86 which frictionally contact the two respective rim portions 88, 90 of the surface 62 of the pulley 26. The cord windings which are contained within the housing 30 are therefore located within either the groove 40 of the pulley 26 or the alcove 76 of the shuttle 58.

[0024] When the recoil starter assembly 22 is in the recoiled state 32, as best shown in FIG. 3, the first winding 54 of the cord 24 is both wound about the pulley 26 and over the roller 74 of the shuttle 58 of the releasable coupling 48. During pulling of the cord 24, the tensile force produced is translated into the radial or normal force 72 and a tangential force or generally the torsional force 63. The normal force 72 causes the shuttle 58 to fictionally engage the radial surface 62 of the recoil pulley 26 and the tangential force 63 contributes toward the circumferential movement of the shuttle 58. Because the tangential force 63 generally overcomes any resistive biasing force of the start assist device 34, the shuttle 58 moves counter-clockwise with the pulley 26 until the shuttle 58 contacts the stop 64 carried by the housing 30. Upon contact, the operator must exert a sufficient amount of additional pulling force to generally overcome the frictional force 72 between the shuttle 58 and the pulley 26.

[0025] With continued pulling of the cord 24 the next

successive winding which was generally wound a full three hundred and sixty degrees about the pulley 26, and not the roller 74, now enters the alcove 76 and travels over the roller 74, back down into the groove 40 of the pulley 26, and out of the conduit 28 to exit the housing 30. Each winding successively travels over the roller 74 as it leaves or exits the housing 30 until the last winding 56 comes to a rest over the roller 74, as best illustrated in FIG. 1 as the unwound state 42.

[0026] More specific to the carburetor 34, a body 92 carries a conventional fuel-and-air mixing passage 94 having a venturi region 96 disposed between an upstream region 98 and a downstream region 100. A butterfly-type throttle valve 102 operatively engages the butterfly-type choke valve 50 via a cam linkage 104. Both valves 50, 102 are engaged rotatably to the body 92 with the choke valve 50 disposed in the upstream region 98 and the throttle valve 102 disposed in the downstream region 100. Referring to FIG. 4, when the engine is either shut down or running at normal operating temperatures and idling speed, the choke valve 50 is biased into a full open position 106 and the throttle valve 102 is biased into an engine idle position 108 by respective torsional springs (not shown).

[0027] When the cord 24 of the recoil starter assembly 22 is initial pulled, the Bowden wire 52 moves for a distance pre-established by the location of the stop 64 of the housing 30 which is far enough to move the butterfly-type choke valve 50 from the spring biased full open position 106 to an actuation or closed position 110, as best illustrated in FIG. 1. This counter-clockwise rotation of the choke valve 50 causes engagement of the cam linkage 104 between the valves 50, 102 which rotates the throttle valve 102 clockwise against the biasing force of the throttle spring from the idle position 108 (as viewed in FIG. 4) and into an engine cold-start position 112 (as viewed in FIG. 1). When the cord is released, the clockwise rotation of the pulley 26 moves the releasable coupling 48 clockwise away from the stop 64 and toward a recoil stop 114 carried by the housing 30 and which defines the opposite end of the channel 60. The recoiling action of the pulley 26 causes the shuttle 58 to temporarily contact the recoil stop 114 creating a degree of slack within the Bowden wire 52 which can be taken-up by a slack retention device 116, as illustrated in FIG. 2.

[0028] This release of tension within the Bowden wire 52 also enables the biasing force of the choke spring to rotate the choke valve 50 clockwise from the closed position 110 (as viewed in FIG. 1) and into an engine warm-up or partial choke state 118 (as viewed in FIG. 2). During this rotation of the choke valve 50, the cam linkage 104 and the cam surface 128 slightly close the throttle valve 102, moving the throttle valve 102 from the cold-start position 112 to an engine warm-up or fast idle position 113, which decreases the richness of the fuel-and-air mixture delivered to the engine yet is still richer than normal running conditions. Further clockwise rotation of the choke valve 50 from the warm-up state 118 and into the

open position 106 is prevented by a latch or tab 133 of the cam linkage 104. The cam linkage 104 is released when the operator manually actuates the throttle which causes the throttle valve 102 to rotate in an opening direction or clockwise against the bias of the throttle spring, thus releasing or clearing the choke valve 50 which moves to the full open position 106.

[0029] The Bowden wire or linkage 52 is engaged pivotally to a distal end of an arm 120 of the choke valve 50 which projects radially outward from an end of a rotating shaft 122 of the choke valve 50. The shaft 122 is rotatably engaged to the body 92 and traverses the upstream region 98 of the fuel and air mixing passage 94. Pivoting action of the arm 120 via pulling of the linkage 52 causes the shaft 122 to rotate and a plate 124 of the valve 50 disposed operatively in the passage 98 to pivot thus opening or closing the passage 98.

[0030] A radially projecting member 126 of the cam linkage 104 projects radially outward from the same end of the shaft 122 of the choke valve 50. The projecting member 126 has a cam surface 128 which contacts a contact face 130 of a lever 132 projecting radially outward from a rotating shaft 134 of the butterfly-type throttle valve 102. As the choke valve 50 rotates from the open position 106, which is preferably biased open by a torsional spring not shown, to the full closed position 110, the cam surface 128 of the cam linkage 104 carried by the choke valve 50 contacts the contact face 130 of the cam linkage 104 carried by the throttle valve 102, causing the throttle valve 102 to move from the biased engine idle position 108 (as best illustrated in FIG. 4) to the partially open or engine cold-start position 112. Consequently, whenever the cord or starter rope 24 is being pulled generally beyond the first winding 54, the choke valve 50 will be tightly closed and the throttle valve 102 will be in the cold-start position 112 unless the throttle is simultaneously actuated by the operator.

[0031] Alternatives to the cam linkage 104 can be incorporated into the carburetor 34. One such modification is the choke and throttle valve cam linkage taught in Patent Application Serial Number 10/621,937, filed July 17, 2003 and incorporated herein by reference.

[0032] Release of the cord 24 by the operator will cause the releasable coupling 48 to move clockwise with the spring-induced recoiling of the pulley 26, as best shown in FIG. 2. The torsional spring bias of the choke valve 50 causes the choke valve 50 to slip back or rotate clockwise to the partially open or warm-up state 118, as best shown in FIG. 2, which is pre-established by a tab 133 projecting radially outward from the cam surface 128. More specifically, as the choke valve 50 rotates clockwise from the closed position 110 to the warm-up state 118, due to the bias of the choke spring, the cam surface 128 carried by the choke valve 50 slides along the cam face 130 carried by the throttle valve 102, causing the throttle valve 102 to slightly close. This sliding action continues until the tab 133 is caught by or contacts the distal end of the lever 132, at which point the choke valve 50 is in

the warm-up state 118 and the throttle valve is in the warm-up position 113. When the operator opens the throttle after the engine has sufficiently warmed-up, thus rotating the throttle valve 106 clockwise which moves the lever 132, the cam linkage 104 is released and the choke valve 50 rotates to the full open position 106 via the biasing force of the choke spring.

[0033] Referring to FIG. 7, a modification of the first embodiment is illustrated wherein the frictional interface 61 between the releasable coupling 48 and the pulley 26 is eliminated. Instead, the shuttle 58', illustrated in FIG. 7, has a pair of generally pie shaped plates 140 which project radially inward on either side of a recoil pulley 26' to rotatably attach to an axis or shaft 82' of the pulley. The plates 140 radially space or hold the shuttle 58' outward from the pulley 26'. With this arrangement, the shuttle 58' moves circumferentially with respect to the shaft 82' via generally a tangential force 63' produced when pulling the cord 24' or when the pulley 26' is recoiling.

[0034] Referring to FIG. 8, a third modification of the present invention is illustrated wherein the friction produced between a surface 70" of a shuttle 58" and a surface 62" of a pulley 26" is reduced (relative to the frictional interface 61 of the first embodiment) by a series of wheels or roller bearings 150 disposed therebetween.

[0035] Referring to FIG. 9, yet a fourth modification of the present invention is illustrated wherein a releasable coupling 48" of a recoil starter assembly 22" has a fork shaped shuttle 58" which moves linearly and tangentially with respect to a recoil pulley 26" to pull upon a linkage 52" thereby actuating a start assist device (not shown). The linear movement of the shuttle 58" is guided by a channel 60" and a stationary pin 161 which projects generally laterally past and between the prongs of the fork shaped shuttle 58". With the initial pull of a pull-cord 24", the pulley 26" rotates counter-clockwise and a ramped projection 162 of the releasable coupling 48" which projects radially outward from the pulley 26" engages the forked shuttle 58" causing it to move linearly along the channel 60" carried by a housing 30" of the assembly 22". Once the shuttle 58" has moved and pulled upon the linkage 52" to actuate an external start assist device, it shall remain in the present position until the external start assist device return pulls upon the linkage 52".

[0036] Referring to FIG. 10, a fifth modification of a pull-cord start system 20" is illustrated wherein a start assist device 34" is actuated by the recoil starter assembly 22 (viewed in FIG. 1) having a releasable clutch coupling with a torsion spring as previously described. The start assist device 34", however, is not the carburetor of FIG. 1, but instead is a yieldably biased-closed, pressure relief valve which when opened, relieves any air pressure within a combustion chamber 170 of an engine 172. The valve 34" is yieldably biased closed and opens to relieve any air pressure trapped in the combustion chamber 170 when the shuttle 58 is moved to an actuation state 65 by the pulling of the cord 24 as previously described. Relieving this pressure upon the initial pull of the pull-cord

24 prevents any potential kick-back of the pull-cord 24 during starting of the engine. When the pull-cord 24 is released, the shuttle 58 moves out of the actuation state 65, and the valve 34" closes to its normally biased position. The engine starts when the torsion spring is sufficiently wound and releases to rotate the crankshaft.

Claims

1. A pull-cord start system for a combustion engine comprising:

an engine start assist device (34);
 a housing (30);
 a recoil pulley (26) disposed in the housing (30), having an axis of rotation (82) and connectable to a crankshaft of the engine;
 a cord (24) having a first winding (54) and last winding (56) wound about the recoil pulley (26) when in the recoiled state, a first end (38) adjacent the first winding (54) for actuation by an operator, and a second end (44) adjacent the last winding (56) and engaged to the pulley (26);
 and **characterized by**

a releasable coupling (48) adjacent the pulley (26), constructed and arranged to interact with the same recoil pulley (26), and disposed at least in part in the housing (30), movable about the periphery of the pulley (26) between circumferentially spaced-apart actuated and retracted positions, and operably connected to the engine start assist device (34) to actuate the assist device (34) when moved to the actuated position;
 a linkage (52) operably connecting the coupling (48) with the start assist device (34);
 a roller (74) carried by the releasable coupling (48) with an axis (80) parallel to the axis of rotation (82) of the pulley (26); and **characterised by**
 the cord (24) passing from the pulley (26) over the roller (74) radially outboard of the axis (80) of the roller (74) and the pulley (26) and returning to the pulley (26) between the ends (38,44) of the cord (24) so that initial pulling of the cord (24) by an operator causes the cord (24) to unwind and rotate the recoil pulley (26) and the releasable coupling (48) to move from the retracted position to the actuated position to actuate the start assist device (34).

2. The pull-cord start system set forth in claim 1 comprising:

a circumferential surface of the recoil pulley (26);
 a groove (40) of the recoil pulley (26) opened radially outward for receiving the cord (24);
 a channel (60) defined radially between the

- housing (30) and the circumferential surface;
and
- wherein the releasable coupling (48) is disposed in part in the channel (60).
3. The pull-cord start system set forth in claim 1 wherein the start assist device (34) is a carburetor (34) having a choke valve (50) and a throttle valve (102).
4. The pull-cord system set forth in claim 3 comprising:
- the choke valve (50) of the carburetor (34) is connected to the linkage (52);
- wherein the releasable coupling (48) drives the linkage (52) upon initial pulling of the cord (24) which causes the choke valve (50) to close and the choke valve closure to partially open the throttle valve (102).
5. The pull-cord start system set forth in claim 1 wherein the start assist device (34) is a pressure relief valve which communicates with a combustion chamber of the engine.
6. The pull-cord start system set forth in claim 2 comprising:
- the recoil pulley (26) having a recoiled state, an unwound state and a central axis (82);
a shuttle (58) of the releasable coupling (48) disposed slidably in the channel (60); and
- wherein the linkage (52) is connected to the shuttle (58).
7. The pull-cord system set forth in claim 6, wherein the roller (74) of the coupling (48) is engaged rotatably to the shuttle (58) within the channel (60), the roller (74) having a rotational axis (80) disposed parallel to the central axis (82) and disposed radially outward of the recoil pulley (26);
wherein the first winding (54) of the cord (24) is wound over the roller (74) and the recoil pulley (26) and the last winding (56) is wound only about the recoil pulley (26) when the recoil pulley (26) is in the recoiled state; and
wherein the first winding (54) is withdrawn from the housing (30) and the last winding (56) is wound over the roller (74) when the recoil pulley (26) is in the unwound state.
8. The pull-cord start system set forth in claim 7 comprising:
- a stop (64) carried by the housing (30) and defining a first end of the channel (60); and
- wherein the shuttle (58) contacts the stop (64) as the cord (24) is withdrawn from the housing (30).
9. The pull-cord start system set forth in claim 8 comprising:
- a recoil stop (114) carried by the housing (30) and defining a second end of the channel (60); and
- wherein the shuttle (58) contacts the recoil stop (114) as the pulley (26) recoils and the cord (24) rewinds back into the housing (30).
10. The pull-cord start system set forth in claim 9 comprising a radially inward facing surface (70) of the shuttle (58) being in releasable frictional engagement with the circumferential surface of the recoil pulley (26) as the shuttle (58) moves circumferentially between the pull and recoil stops (114).
11. The pull-cord start system set forth in claim 9 comprising a plurality of friction reducing wheels disposed between the shuttle (58) and the recoil pulley (26).
12. The pull-cord start system set forth in claim 11 wherein the plurality of wheels are engaged rotatably to the shuttle (58) and ride upon the circumferential surface of the pulley (26).
13. The pull-cord start system set forth in claim 9 comprising a plurality of bearings (150) disposed between the shuttle (58) and the recoil pulley (26).
14. The pull-cord start system set forth in claim 9 comprising:
- a shaft (82') disposed concentrically to the axis of rotation (82);
a radially extending plate (140) engaged to the shuttle (58') and attached rotatably to the shaft (82'); and
- wherein the shuttle (58') is spaced radially from the recoil pulley (26').
15. The pull-cord start system set forth in claim 1 comprising:
- a start assist device (34) having an actuated position and a normal operating yieldably biased position;
a housing (30);
the recoil pulley (26) connected by the coupling (48) to a crankshaft of the engine, the recoil pulley (26) having a central axis (82), a yieldably biased recoiled state and an unwound state;

a shuttle (58) in operable relationship with the recoil pulley (26), the shuttle (58) having an actuation position;
 the linkage (52) operably connecting to the shuttle (58) and the start assist device (34);
 the roller (74) being engaged rotatably to the shuttle (58) about a rotational axis (80) disposed parallel to the central axis (82) of the recoil pulley;
 the first winding (54) of the cord (24) is wound over the roller (74) and the recoil pulley (26) and the last winding (56) is wound about only the recoil pulley (26) when the recoil pulley (26) is in the recoiled state; and
 the last winding (56) of the cord (24) is substantially wound over the roller (74) and the recoil pulley (26) and the first winding (54) is disposed outside of the housing (30) when the recoil pulley (26) is in the unwound state.

16. The pull-cord start system set forth in claim 15 wherein unwinding of the first winding (54) by a manual pull of the cord (24) by the operator causes the recoil pulley (26) to rotate and the shuttle (58) to move into the actuation state which moves the start assist device (34) into the actuation position via the linkage (52).
17. The pull-cord start system set forth in claim 16 wherein the shuttle (58) remains in the actuation position as the cord (24) is being pulled by the operator and when the recoil pulley (26) is in the unwound state.

Patentansprüche

1. Ein Seilzugstartsystem für eine Brennkraftmaschine umfassend:

eine Motorstartunterstützungsvorrichtung (34), ein Gehäuse (30),
 eine im Gehäuse (30) angeordnete Wiederaufwickelseilscheibe (26), die eine Rotationsachse (82) hat und mit einer Kurbelwelle des Motors verbindbar ist, ein Seil (24) mit einer ersten Windung (54) und einer letzten Windung (56), die um die Wiederaufwickelseilscheibe (26) gewickelt sind, wenn sie im aufgewickelten Zustand ist, während ein erstes Ende (38) benachbart zur ersten Windung (54) für die Betätigung durch einen Anwender ist und ein zweites Ende (44) benachbart zur letzten Windung (56) und mit der Seilscheibe (26) in Eingriff ist, **gekennzeichnet durch**
 eine lösbare Kupplung (48), die zur Seilscheibe (26) benachbart ist, die zum Interagieren mit derselben Wiederaufwickelseilscheibe (26) konstruiert und angeordnet ist und mindestens

teilweise im Gehäuse (30) angeordnet ist, die entlang des Umfangs der Seilscheibe (26) zwischen umfänglich beabstandeten betätigten und zurückgezogenen Positionen bewegbar ist und betriebsbereit mit der Motorstartunterstützungsvorrichtung (34) verbunden ist, um die Unterstüzungsvorrichtung (34) zu betätigen, wenn sie in die betätigte Position bewegt wird, eine Verbindung (52), die die Kupplung (48) mit der Startunterstützungsvorrichtung (34) betriebsbereit verbindet,
 eine **durch** die lösbare Kupplung (48) getragene Rolle (74) mit einer Achse (80), die parallel zur Rotationsachse (82) der Seilscheibe (26) ist, **dadurch gekennzeichnet, dass**
 das Seil (24) von der Seilscheibe (26) über die Rolle (74) radial außerhalb der Achse (80) der Rolle (74) und der Seilscheibe (26) läuft und zur Seilscheibe (26) zwischen den Enden (38, 44) des Seils (24) zurückläuft, so dass das anfängliche Ziehen des Seils (24) **durch** einen Anwender ein Abwickeln des Seils (24) und ein Drehen der Wiederaufwickelseilscheibe (26) sowie bei der lösbaren Kupplung (48) ein Bewegen von der zurückgezogenen Position in die betätigte Position bewirkt, um die Startunterstützungsvorrichtung (34) zu betätigen.

2. Das Seilzugstartsystem gemäß Anspruch 1 umfassend:

eine umfängliche Oberfläche der Wiederaufwickelseilscheibe (26),
 eine Rille (40) der Wiederaufwickelseilscheibe (26), die radial nach außen geöffnet ist, um das Seil (24) aufzunehmen,
 einen Kanal (60), der radial zwischen dem Gehäuse (30) und der umfänglichen Oberfläche definiert ist, und
 in dem die lösbare Kupplung (48) teilweise in dem Kanal (60) angeordnet ist.

3. Das Seilzugstartsystem gemäß Anspruch 1, in dem die Startunterstützungsvorrichtung (34) ein Vergaser (34) mit einem Choke-Ventil (50) und einem Drosselventil (102) ist.

4. Das Seilzugstartsystem gemäß Anspruch 3 umfassend:

das Choke-Ventil (50) des Vergasers (34) ist mit der Verbindung (52) verbunden, während die lösbare Kupplung (48) die Verbindung (52) auf Grund des anfänglichen Ziehens des Seils (24) antreibt, was ein Schließen des Choke-Ventils (50) bewirkt und die Choke-Ventilschließung bewirkt ein teilweises Öffnen des Drosselventils (102).

5. Das Seilzugstartsystem gemäß Anspruch 1, in dem die Startunterstützungsvorrichtung (34) ein Überdruckventil ist, das mit einer Brennkammer des Motors in Verbindung steht.
6. Das Seilzugstartsystem gemäß Anspruch 2 umfassend:
 die Wiederaufwickelseilscheibe (26), die einen aufgewickelten Zustand, einen abgewickelten Zustand und eine Mittelachse (82) aufweist, einen Schlitten (58) der lösbaren Kupplung (48), der verschiebbar im Kanal (60) angeordnet ist, und in dem die Verbindung (52) mit dem Schlitten (58) verbunden ist.
7. Das Seilzugstartsystem gemäß Anspruch 6, in dem die Rolle (74) der Kupplung (48) drehbar mit dem Schlitten (58) innerhalb des Kanals (60) in Eingriff steht, während die Rolle (74) eine Rotationsachse (80) aufweist, die parallel zur Mittelachse (82) und radial außerhalb der Wiederaufwickelseilscheibe (26) angeordnet ist, in dem die erste Windung (54) des Seils (24) über die Rolle (74) und die Wiederaufwickelseilscheibe (26) gewickelt ist und die letzte Windung (56) nur um die Wiederaufwickelseilscheibe (26) gewickelt ist, wenn die Wiederaufwickelseilscheibe (26) sich im aufgewickelten Zustand befindet, und in dem die erste Windung (54) aus dem Gehäuse (30) gezogen ist und die letzte Windung (56) über die Rolle (74) gewickelt ist, wenn die Wiederaufwickelseilscheibe (26) sich im abgewickelten Zustand befindet.
8. Das Seilzugstartsystem gemäß Anspruch 7 umfassend:
 einen Anschlag (64), der durch das Gehäuse (30) getragen wird und der ein erstes Ende des Kanals (60) definiert, und in dem der Schlitten (58) mit dem Anschlag (64) in Kontakt kommt, wenn das Seil (24) aus dem Gehäuse (30) gezogen wird.
9. Das Seilzugstartsystem gemäß Anspruch 8 umfassend:
 einen Wiederaufwickelanschlag (114), der durch das Gehäuse (30) getragen wird und ein zweites Ende des Kanals (60) definiert, und in dem der Schlitten (58) mit dem Wiederaufwickelanschlag (114) in Kontakt kommt, wenn sich die Seilscheibe (26) wieder aufwickelt und das Seil (24) im Gehäuse (30) aufgewickelt wird.
10. Das Seilzugstartsystem gemäß Anspruch 9 umfassend:
 eine radial einwärts gerichtete Oberfläche (70) des Schlittens (58), die in lösbarem Reibungseingriff mit der umfänglichen Oberfläche der Wiederaufwickelseilscheibe (26) ist, wenn der Schlitten (58) sich umfänglich zwischen den Zug- und Wiederaufwickelanschlägen (114) bewegt.
11. Das Seilzugstartsystem gemäß Anspruch 9, umfassend:
 eine Mehrzahl von reibungsreduzierenden Rädern, die zwischen dem Schlitten (58) und der Wiederaufwickelseilscheibe (26) angeordnet ist.
12. Das Seilzugstartsystem gemäß Anspruch 11, in dem die Mehrzahl von Rädern drehbar mit dem Schlitten (58) in Eingriff steht und auf der umfänglichen Oberfläche der Seilscheibe (26) läuft.
13. Das Seilzugstartsystem gemäß Anspruch 9, umfassend:
 eine Mehrzahl von Lagern (150), die zwischen dem Schlitten (58) und der Wiederaufwickelseilscheibe (26) angeordnet ist.
14. Das Seilzugstartsystem gemäß Anspruch 9, umfassend:
 einen konzentrisch zur Rotationsachse (82) angeordneten Schaft (82'),
 eine sich radial erstreckende Platte (140), die mit dem Schlitten (58') in Eingriff steht und drehbar an dem Schaft (82') angeordnet ist, und in dem der Schlitten (58') radial von der Wiederaufwickelseilscheibe (26') beabstandet ist.
15. Das Seilzugstartsystem gemäß Anspruch 1 umfassend:
 eine Startunterstützungsvorrichtung (34), die eine betätigte Position und eine normale, nachgiebig vorgespannte Betriebsposition aufweist, ein Gehäuse (30), während die Wiederaufwickelseilscheibe (26) durch die Kupplung (48) mit einer Kurbelwelle des Motors verbunden ist, die Wiederaufwickelseilscheibe (26) weist eine Mittelachse (82), einen nachgiebig vorgespannten aufgewickelten Zustand und einen abgewickelten Zustand auf, einen Schlitten (58), der in einer betriebsbereiten Beziehung mit der Wiederaufwickelseilscheibe (26) ist, während der Schlitten (58) eine Betätigungsposition aufweist,

die Verbindung (52) verbindet den Schlitten (58) und die Startunterstützungsvorrichtung (34) betriebsbereit,

die Rolle (74) steht mit dem Schlitten (58) drehbar um eine Rotationsachse (80) in Eingriff, die parallel zur Mittelachse (82) der Wiederaufwickelseilscheibe angeordnet ist,

die erste Windung (54) des Seils (24) ist über die Rolle (74) und die Wiederaufwickelseilscheibe (26) gewickelt und die letzte Windung (56) ist nur über die Wiederaufwickelseilscheibe (26) gewickelt, wenn die Wiederaufwickelseilscheibe (26) sich im aufgewickelten Zustand befindet, und

die letzte Windung (56) des Seils (24) ist im Wesentlichen über die Rolle (74) und die Wiederaufwickelseilscheibe (26) gewickelt und die erste Windung (54) ist außerhalb des Gehäuses (30) angeordnet, wenn die Wiederaufwickelseilscheibe (26) sich im abgewickelten Zustand befindet.

16. Das Seilzugstartsystem gemäß Anspruch 15, in dem das Abwickeln der ersten Windung (54) durch ein manuelles Ziehen des Seils (24) durch den Anwender ein Drehen der Wiederaufwickelseilscheibe (26) und ein Bewegen des Schlittens (58) in den Betätigungszustand bewirkt, der die Startunterstützungsvorrichtung (34) über die Verbindung (52) in die Betätigungsposition bewegt.

17. Das Seilzugstartsystem gemäß Anspruch 16, in dem der Schlitten (58) in der Betätigungsposition bleibt, wenn das Seil (24) durch den Anwender gezogen wird und wenn die Wiederaufwickelseilscheibe (26) sich im abgewickelten Zustand befindet.

Revendications

1. Système de démarrage par câble pour un moteur à combustion comprenant :

un dispositif d'assistance au démarrage du moteur (34) ;

un carter (30) ;

une poulie de retour (26) disposée dans le carter (30), présentant un axe de rotation (82) et pouvant être reliée à un vilebrequin du moteur ;

un câble (24) présentant un premier enroulement (54) et dernier enroulement (56) enroulés autour de la poulie de retour (26) à l'état de retour, une première extrémité (38) adjacente au premier enroulement (54) pour l'actionnement par un opérateur, et une seconde extrémité (44) adjacente au dernier enroulement (56) et engrenant dans la poulie ; et **caractérisé par**

un accouplement détachable (48) adjacent à la

poulie (26), conçu et arrangé pour interagir avec la même poulie de retour (26), et disposé au moins en partie dans le carter (30), mobile autour de la périphérie de la poulie (26) entre des positions actionnée et rétractée espacées sur la circonférence, et relié de manière opérationnelle au dispositif d'assistance au démarrage du moteur (34) pour actionner le dispositif d'assistance (34) lorsqu'il est déplacé dans la position actionnée ;

un organe de liaison (52) reliant de manière opérationnelle l'accouplement (48) au dispositif d'assistance au démarrage (34) ;

un rouleau (74) porté par l'accouplement détachable (48) avec un axe (80) parallèle à l'axe de rotation (82) de la poulie (26) ; et **caractérisé en ce que**

le câble (24) passe depuis la poulie (26) par le rouleau (74) radialement à l'extérieur de l'axe (80) du rouleau (74) et de la poulie (26) et retourne vers la poulie (26) entre les extrémités (38, 44) du câble (24) de sorte qu'un tirage initial du câble (24) par un opérateur a pour conséquence que le câble (24) se déroule et tourne la poulie de retour (26) et que l'accouplement détachable (48) se déplace de la position rétractée à la position actionnée pour actionner le dispositif d'assistance au démarrage (34).

2. Système de démarrage par câble selon la revendication 1 comprenant :

une surface circonférentielle de la poulie de retour (26) ;

une rainure (40) de la poulie de retour (26) ouverte radialement vers l'extérieur pour recevoir le câble (24) ;

un canal (60) défini radialement entre le carter (30) et la surface circonférentielle ; et

dans lequel l'accouplement détachable (48) est disposé en partie dans le canal (60).

3. Système de démarrage par câble selon la revendication 1, dans lequel le dispositif d'assistance au démarrage (34) est un carburateur (34) présentant un volet de départ (50) et un papillon (102).

4. Système par câble selon la revendication 3 comprenant :

le volet de départ (50) du carburateur (34) est relié à l'organe de liaison (52) ;

dans lequel l'accouplement détachable (48) entraîne l'organe de liaison (52) lors d'un tirage initial du câble (24) ce qui a pour conséquence que le volet de départ (50) se ferme et que la fermeture du volet de

- départ ouvre partiellement le papillon (102).
5. Système de démarrage par câble selon la revendication 1 dans lequel le dispositif d'assistance au démarrage (34) est une soupape de décharge qui communique avec une chambre de combustion du moteur.
6. Système de démarrage par câble selon la revendication 2, comprenant :
- la poulie de retour (26) qui présente un état de retour, un état déroulé et un axe central (82) ; une navette (58) de l'accouplement détachable (48) disposée de manière à pouvoir glisser dans le canal (60) ; et
- dans lequel l'organe de liaison (52) est relié à la navette (58).
7. Système par câble selon la revendication 6, dans lequel le rouleau (74) de l'accouplement (48) est engrené de manière à pouvoir tourner dans la navette (58) à l'intérieur du canal (60), le rouleau (74) présentant un axe de rotation (80) disposé parallèlement à l'axe central (82) et disposé radialement vers l'extérieur de la poulie de retour (26) ; dans lequel le premier enroulement (54) du câble (24) est enroulé sur le rouleau (74) et la poulie de retour (26) et le dernier enroulement (56) est enroulé seulement autour de la poulie de retour (26) lorsque la poulie de retour (26) est à l'état de retour ; et dans lequel le premier enroulement (54) est retiré du carter (30) et le dernier enroulement (56) est enroulé sur le rouleau (74) lorsque la poulie de retour (26) est à l'état déroulé.
8. Système de démarrage par câble selon la revendication 7 comprenant :
- une butée (64) portée par le carter (30) et définissant une première extrémité du canal (60) ; et
- dans lequel la navette (58) entre en contact avec la butée (64) lorsque le câble (24) est retiré du carter (30).
9. Système de démarrage par câble selon la revendication 8 comprenant :
- une butée de retour (114) portée par le carter (30) et définissant une seconde extrémité du canal (60) ; et
- dans lequel la navette (58) entre en contact avec la butée de retour (114) lorsque la poulie (26) effectue un mouvement de retour et le câble (24) se réenroule
- dans le carter (30).
10. Système de démarrage par câble selon la revendication 9, comprenant une surface tournée radialement vers l'intérieur (70) de la navette (58) se trouvant en prise par frottement détachable avec la surface circonférentielle de la poulie de retour (26) lorsque la navette (58) se déplace de manière circonférentielle entre les butées de tirage et de retour (114).
11. Système de démarrage par câble selon la revendication 9 comprenant une multiplicité de roues de réduction de frottement disposées entre la navette (58") et la poulie de retour (26").
12. Système de démarrage par câble selon la revendication 11 dans lequel la multiplicité de roues est engrenée de manière à pouvoir tourner dans la navette (58") et roule sur la surface circonférentielle de la poulie (26").
13. Système de démarrage par câble selon la revendication 9 comprenant une multiplicité de paliers (150) disposés entre la navette (58") et la poulie de retour (26").
14. Système de démarrage par câble selon la revendication 9 comprenant :
- un arbre (82') disposé de manière concentrique à l'axe de rotation (82) ; une plaque s'étendant radialement (140) engrenée dans la navette (58') et attachée à l'arbre (82') de manière à pouvoir tourner ; et
- dans lequel la navette (58') est espacée radialement par rapport à la poulie de retour (26').
15. Système de démarrage par câble selon la revendication 1 comprenant :
- un dispositif d'assistance au démarrage (34) présentant une position actionnée et une position prétendue pouvant céder à fonctionnement normal ; un carter (30) ; la poulie de retour (26) reliée par l'accouplement (48) à un vilebrequin du moteur, la poulie de retour (26) présentant un axe central (82), un état de retour prétendu de manière à pouvoir céder et un état déroulé ; une navette (58) en relation opérationnelle avec la poulie de retour (26), la navette (58) présentant une position d'actionnement ; l'organe de liaison (52) étant relié de manière opérationnelle à la navette (58) et au dispositif d'assistance au démarrage (34) ; le rouleau (74) étant engrené de manière à pou-

voir tourner dans la navette (58) autour d'un axe de rotation (80) disposé parallèlement à l'axe central (82) de la poulie de retour ;

le premier enroulement (54) du câble (24) est enroulé sur le rouleau (74) et la poulie de retour (26) et le dernier enroulement (56) est enroulé seulement autour de la poulie de retour (26) lorsque la poulie de retour (26) est à l'état de retour ; et

le dernier enroulement (56) du câble (24) est enroulé essentiellement sur le rouleau (74) et la poulie de retour (26) et le premier enroulement (54) est disposé à l'extérieur du carter (30) lorsque la poulie de retour (26) est à l'état déroulé.

16. Système de démarrage par câble selon la revendication 15 dans lequel le déroulement du premier enroulement (54) par un tirage manuel sur le câble (24) par l'opérateur a pour conséquence que la poulie de retour (26) tourne et que la navette (58) se déplace dans l'état d'actionnement ce qui met le dispositif d'assistance au démarrage (34) dans la position d'actionnement en passant par l'organe de liaison (52).

17. Système de démarrage par câble selon la revendication 16 dans lequel la navette (58) reste dans la position d'actionnement lorsque le câble (24) est tiré par l'opérateur et lorsque la poulie de retour (26) est à l'état déroulé.

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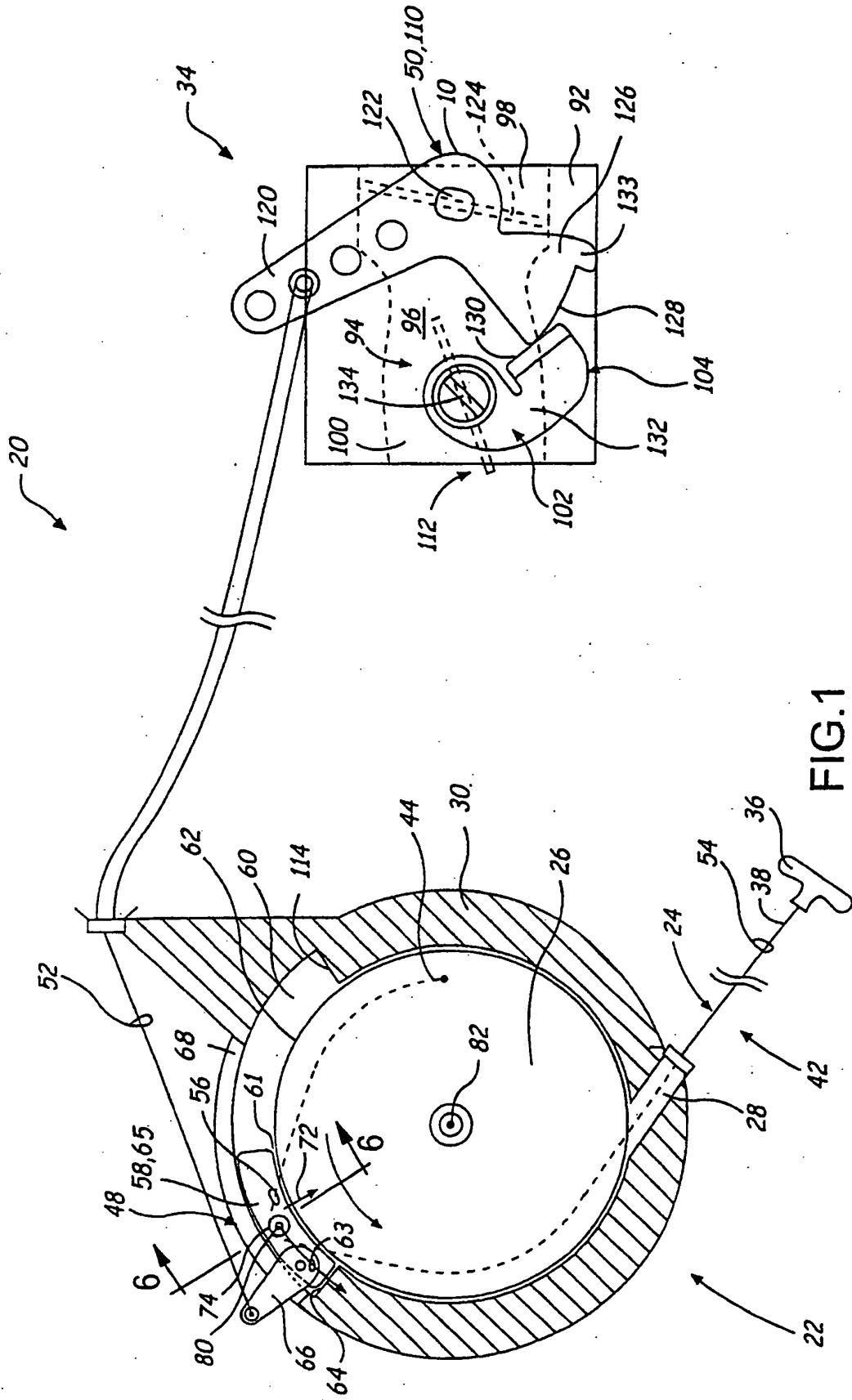


FIG.1

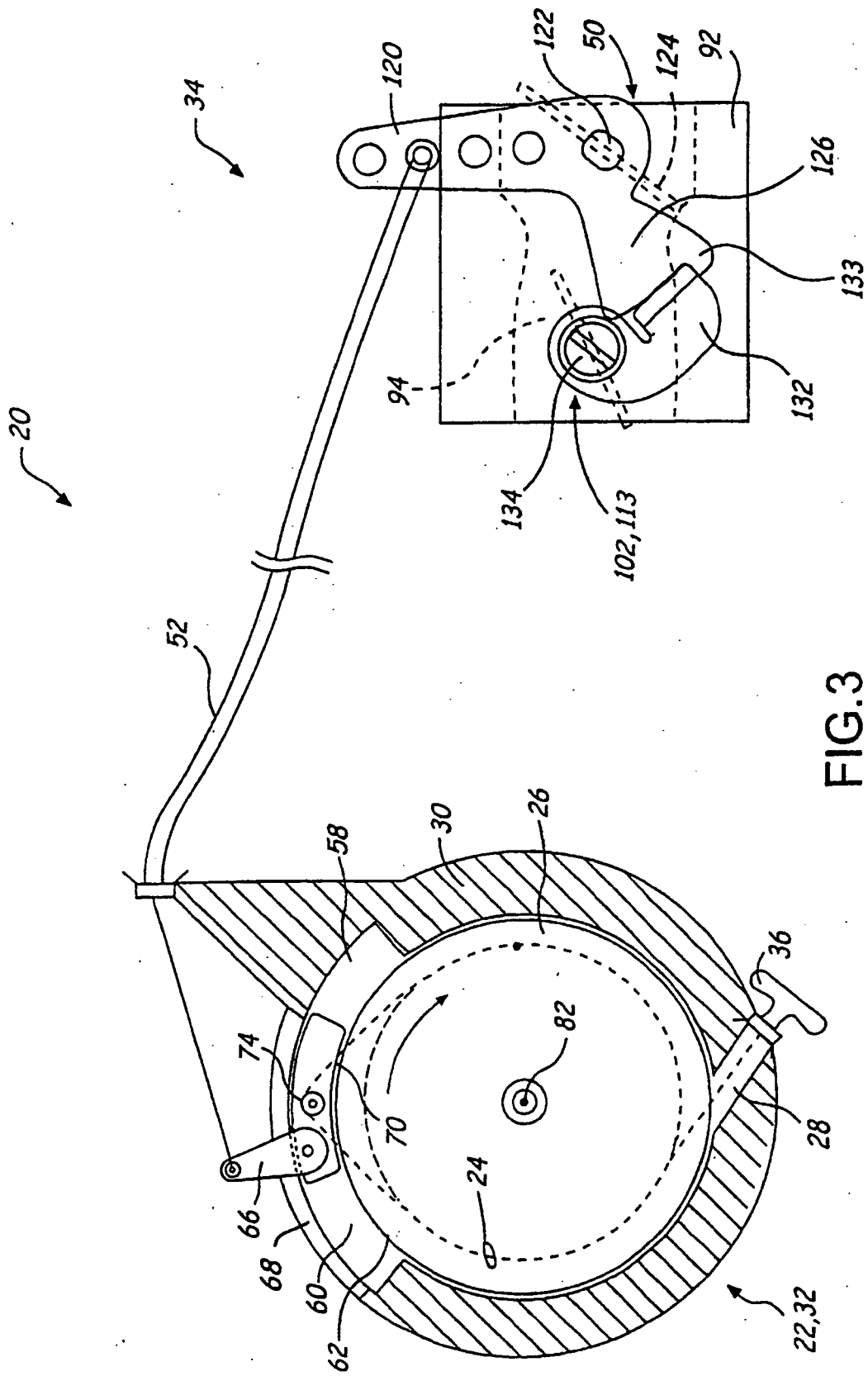


FIG.3

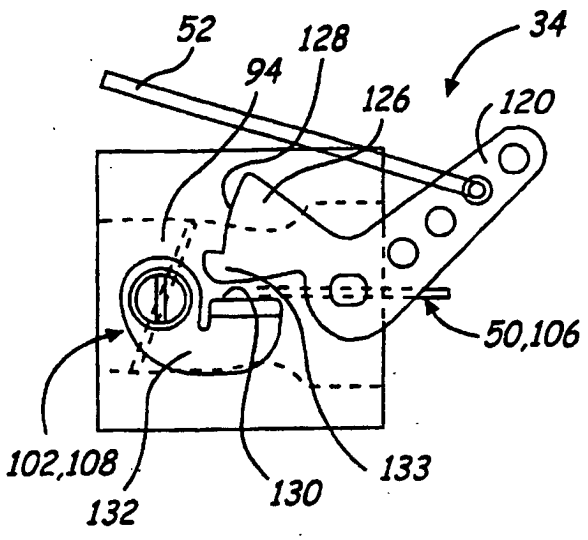


FIG. 4

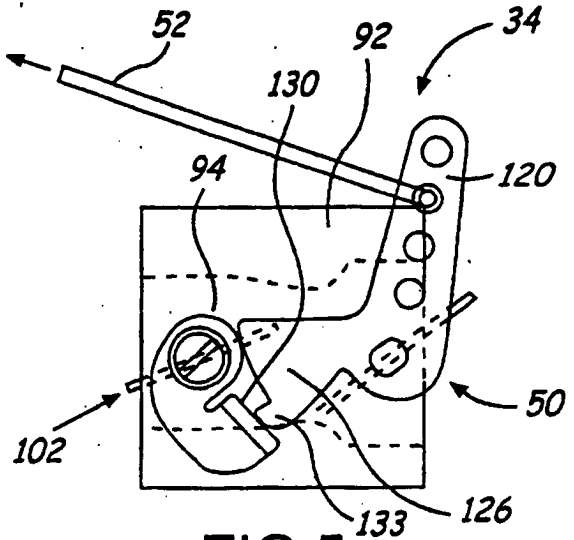


FIG. 5

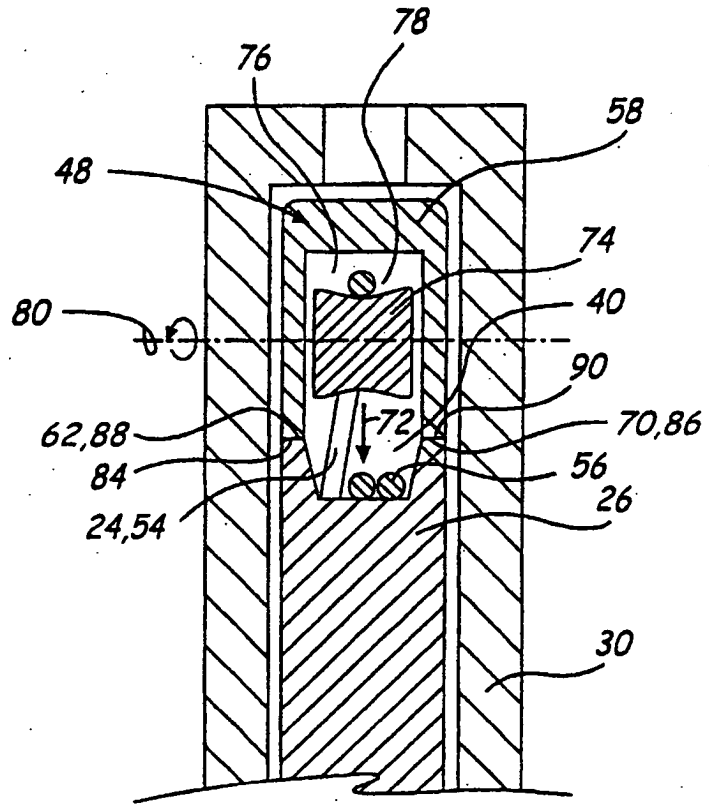


FIG. 6

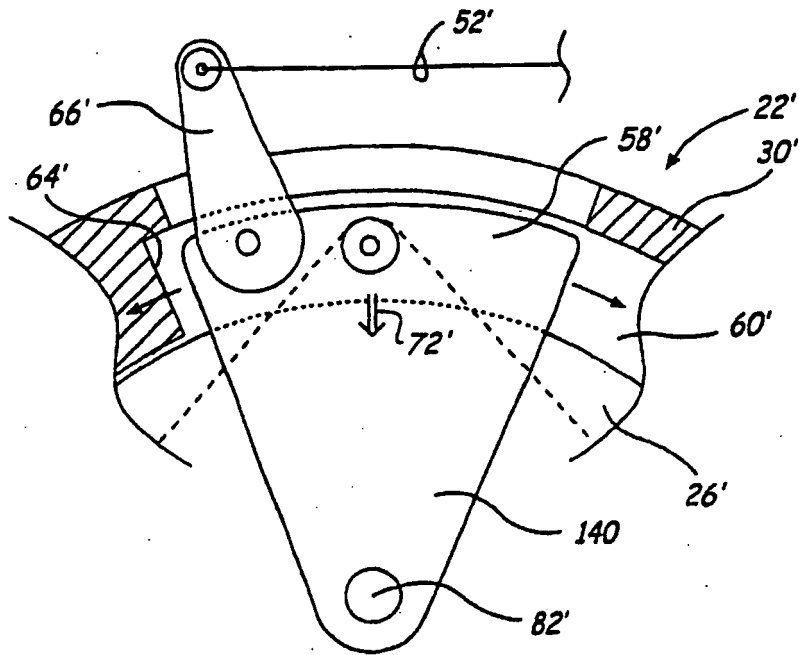


FIG. 7

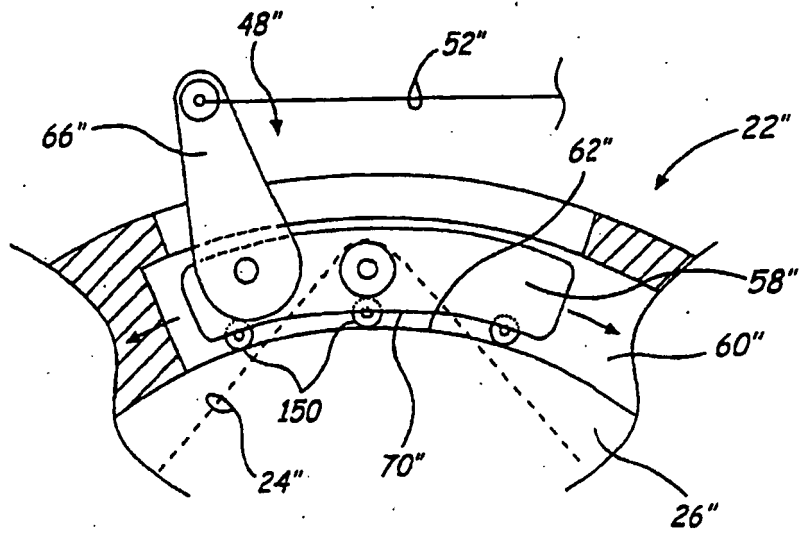


FIG. 8

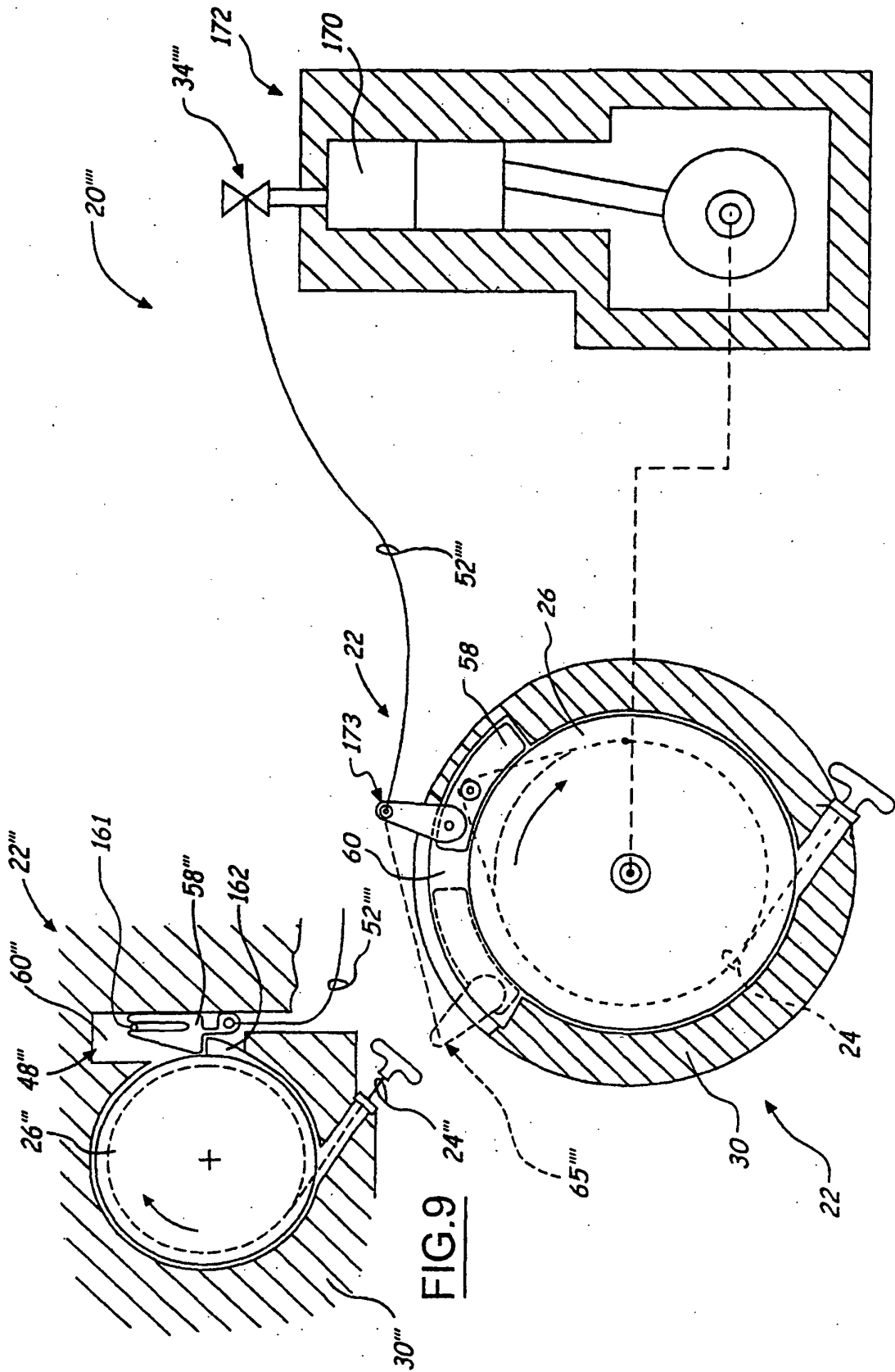


FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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